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EXPERIMENTS WITH
DECIDUOUS FRUITS

AT AND NEAR THE SOUTHERN COAST RANGE SUB-STATION,
PASO ROBLES, FROM 1889 TO 1902

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STEINBECK ORCHARD, NEAR TEMPLETON

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EXPERIMENTS WITH DECIDUOUS FRUITS AT AND NEAR THE SOUTHERN COAST RANGE STATION.

The purpose of this bulletin is to give a clear and exact account of experiments conducted by the California Station during a period of thirteen years in order to ascertain the possibilities of deciduous-fruit culture upon the substation tract east of the Salinas River, near the town of Paso Robles, and upon similar soils in that and other districts of the Southern Coast Range.

So far as the Station and its workers are concerned, these results are practically final, excepting as otherwise stated in the following pages; and those who propose to plant orchards on similar soils, under similar climatic conditions, can take the conclusions reached in this bulletin as those of thirteen years' experience, with much expenditure of time and money, and a very careful study of a large area of contiguous country.

The problem in regard to orchards presented to an experimenter in a given district is always a complex one, especially if that district, while untried, is under rapid industrial improvement. There is, then, every possible temptation offered to the community to become very enthusiastic over all sorts of new and promising crops, of which fruit, one of the great resources of old and long-settled regions, naturally receives immediate attention. Orchard planting in such cases far outruns the slow but steady efforts of the experimenter, and often duplicates his failures or successes before he can reach, much less publish, trustworthy results. Meanwhile the work of the experimenter goes on, directed to the ascertainment of certain definite results. He wishes to know what fruits can be made commercially successful in the district, what fruits can be grown in a small way for family use, and what fruits should be entirely discarded. He must exhaust his utmost resources of horticultural experience to give these fruits complete tests under different treatments; he must analyze the causes of success or failure, so as to be able to apply the results of these experiments upon one or several plots of ground to much larger areas, and thus to furnish a more or less trustworthy guide for investors in years to come.

It is always best for would-be orchardists that the results of a long series of investigations be stated with entire frankness, and exactly as

they impress the experimenters, who have no financial interests involved. If further experiments, in after years, modify any adverse conclusion, enlarging the field of successful culture of some of the fruits herein named, it is nevertheless better that the case against them should have been plainly and fully stated.

The planting of fruit trees on unsuitable soils, or where other conditions are strongly adverse, causes great economic loss. In the end, the nurserymen who grew the trees, the local agents who sold them, the land owners, the land dealers, and the entire community are severe sufferers. Errors in respect to annual crops are easily remedied, but errors in regard to crops which it requires several years to bring to bearing age, or, as in such cases as the present, nearly one-third of an average life-time to test thoroughly, are highly expensive. When a region is rapidly passing from pastoral to agricultural conditions, no foresight can prevent such mistakes, for time, patience, close observation, and carefully conducted tests are necessary to determine the natural limitations of any district. Whenever those limitations have been correctly outlined, they must be recognized and thereafter dealt with as accepted facts, and the community must develop its industries accordingly.

GENERAL VIEW OF THE REGION.

One of the most striking features of the Southern Coast Range is the broken chain of valleys, high plains, and passes that form a line of separation between the western and the eastern sides. Along this succession of narrow gateways and broader levels, the Missions of Soledad, San Antonio, San Miguel, and San Luis Obispo were founded and great Spanish ranches came into existence; the railroad of to-day follows much the same route up the Salinas and south to Lompoc.

The country which has been studied lies almost altogether east of this medial line along the Salinas, and occupies portions of San Benito, Monterey, and San Luis Obispo counties. It is in shape an irregular oval, nearly forty miles long by twenty wide, extending south-east and north-west. While extremely diversified in appearance, rising into great peaks, spreading out into broad, rolling plains, or narrowing into winding cañons, it has a unity in soil, climate, and larger agricultural problems that is seldom found in so large an area of hill country.

Upon a preliminary survey, one may begin as far north as La Gloria Valley and the ridges about Cholone Peak in Monterey, and thence come south past the wide channels of the San Lorenzo River and past Slack's Cañon and Indian Valley in the rugged south-eastern

corner of Monterey, where numerous tributaries of the Estrella take rise. Such streams as the Gaviota, which reaches the Salinas at San Ardo, the lesser creeks flowing west to Sargent and Bradley, and the larger water-courses of Indian, Vineyard, San Jacinto, Ranchito, Cholame, Palo Prieto, Antelope, and others are surprisingly alike in appearance and surroundings. The still larger Estrella and its continuation, San Juan Creek flowing down from the high Carisa region, the winding Huerhuero, and even the upper Salinas itself, extending upward past San Ardo, San Miguel, Paso Robles and other thriving towns to Salsipuedes, Rinconadas, and the mining districts, are all of the same type. All are streams of more or less intermittent winter flow; many of them are non-periodic, sometimes for several seasons having no floods and in summer disappearing from sight. Their beds are broad, sandy channels, not very different in appearance from the well-known "washes" of Southern California streams but comparatively free from pebbles. Along these streams are narrow bottoms, then higher benches, sometimes on several levels, on which irrigation from the streams is more or less practicable, but the total area of these lands is small. The valleys and rolling plains east of the Salinas, such as Elkhorn, Carisa, Cholame, Estrella, Huerhuero, Avalan, Long, Antelope, Wild Horse, and, away over on the San Joaquin side, McClures and Kettleman, include very diverse regions, but are all alike in having a more or less fluctuating rainfall, severe frosts, and soils which, though sometimes extremely fertile, are mainly granitic sands and gravels derived from the granite hills about the heads of the Estrella, San Juan, and Salinas. The brownish or blackish soils are derived from the clays, clay-stones, bituminous shales, and various associated rocks of this much-varied region. The Bradley plains on the west side of the Salinas, north of San Miguel, present much the same features as the eastern plains, but have a better soil, derived from the Santa Lucia range, lying west.

My own observations of orchards, made at various times for twenty-five years, have covered the greater part of Monterey and San Luis Obispo, as well as portions of San Benito. My closer studies in recent years have taken me as far south as San José Valley, east almost to La Panza, west to the summits of the Santa Lucias, north to Kings City, and northeast to Slack Cañon. The great ranches of the past have been subdivided and sold. The country is everywhere being utilized for both pastoral and agricultural purposes. As a whole, it possesses much fertile land, many small but prosperous communities, and growing resources. The pioneers have now learned better than ever before the possibilities as well as the limitations of their soils

and their climate. They even find it possible now to produce crops with a much smaller rainfall than was formerly thought needful, and they are making homes upon lands once considered fit only for pasturage. Such towns as Creston, Cholame, and Shandon have been founded upon old cattle-ranges.

SOIL OF THE SUB-STATION.

Before the sub-station was established the Director made an examination of the soils of the region and more especially of the particular tract chosen. This tract has been mapped and described in previous station reports. It is therefore sufficient to say here that it covers twenty acres lying in a parallelogram 495 feet wide and 1720 feet long. The southern part of the tract is a light sand mixed with white hornstone, quartz, feldspar, and claystone debris and containing but a small amount of clay. Most of this light soil is underlaid by a deep sandy "hardpan"** extending from a point one to three feet below the surface downwards to a point six to ten feet lower. Below the hardpan is a sandy soil sometimes containing more clay than the surface

*The hardpan underlying the soils of the station is a grayish mass of coarse grains not bound together by any cementing substance (except in spots where there is a calcareous cement) but formed into a compact rock-like mass by the peculiar wedge-shape structure of the individual grains. It is therefore a mechanical instead of a cement hardpan. A mechanical analysis of a part taken from the third foot of the hardpan column shows the following percentages of fine and coarse grains:

PHYSICAL COMPOSITION OF HARDPAN.				
Diameter of grains.	mm.	Material.	Per cent.	
2.		Very coarse grits	6.9	
2.-1.	"	Coarse grits	12.0	
1.-0.5	"	Medium grits.....	13.5	
.50-.30	"	Very coarse sand.....	7.5	
.30-.16	"	Coarse sand	13.8	
.16-.12	"	Medium sand.....	5.1	
.12-.072	"	Fine sand.....	4.9	
.072-.047	"	Coarse silt.....	6.5	
.047-.036	"	Coarse silt.....	8.1	
.036-.025	"	Medium silt	4.8	
.025-.016	"	Fine silt.....	0.8	
.016-.0023	"	Finest silt	9.8	
.0023-	"	Colloidal clay	5.8	
			99.5	

The percentage of the coarse material is very large, while that of clay and fine silts is very small. There would seem to be an amount of the latter just sufficient to fill the spaces between the large grains and aid in the firming of the mass, rendering it practically impervious to water; and wherever it underlies stream beds, dangerous wet quicksands remain till late in the season. The hardpan yields readily to water, *i.e.*, when a detached lump *above ground* is wetted it quickly falls apart as a mushy mass; but *in situ*, when water is applied to it, while it softens gradually it again becomes firm and compact on drying because of the undisturbed position of its component grains. Even when shattered by blasting, if the fragments are allowed to remain in the hole, they again in the course of time become as firmly compacted as before, thus showing that this is not a cemented hardpan. Hence it was not recognized as a serious obstacle.—R. H. L.

soil, but sometimes gravelly. The back portion of the tract is mostly a gray, silty soil mingled with a good deal of clay, and in portions underlaid by black adobe, breaking in places into the well-known "hog-wallow" or uneven surface common in this region. Between these soils and the sandy hardpan is a swale, or depression across the tract, where the soil is a fine silt with little clay, baking hard in summer, and boggy in winter. Sandy hardpan, gray and heavier, brown and black adobe soil, and fine-silted swale-soil are all remarkably characteristic of a great deal of the region east of the Salinas.

The table on the following page gives the analyses of the soils represented on or near the sub-station tract, taken to a depth of one foot.

The Director, in discussing these soils, in 1889, drew attention to the low moisture absorption in No. 1147, to the small supply of humus and lack of iron in No. 1126, to the necessity of drainage and good tilth of the swale soils (whose value is on many farms much neglected), to the very high contents of lime, potash, humus, and phosphoric acid in the black adobe, and to the lesser value of the brown adobe. The actual use of these soils since 1889 has amply borne out these deductions.

HISTORY OF ORCHARD TO 1894.

Beginning work.—In the spring of 1889 about four hundred varieties of deciduous fruits were planted, including nuts. The list was largely made up from those kinds most successful in Alameda and Santa Clara counties. The trees were cut to three feet, to allow for future trunks of eighteen inches. The collection was as follows: Apples, 90 varieties; cherries, 38 varieties; pears, 65 varieties, besides some seedlings and Japanese stocks; plums and prunes, 70 varieties; peaches and nectarines, 70 varieties; almonds, 10 varieties; apricots, 20 varieties; quinces, 7 varieties; walnuts, pecans and filberts, 14 varieties; besides the preceding, figs, olives, Japanese persimmons, and mulberries were planted. Nearly all of these trees made a fair start; the apples, cherries, and peaches did best. The plums did poorly. All the trees grew best on the granitic, sandy soil, as it was new and the roots had not yet reached the hardpan.

From 1889 to 1894.—During the four years to the winter of 1893-94 much of this orchard gave promise of being of considerable value. The trees were growing very well in most cases, the roots had not reached the hardpan, the rainfall was fairly good; the orchard had not yet reached the point of greatest stress. The difficulties were chiefly due to sunburn, against which the trunks were protected by wraps and shakes; to the flat-head borers (*Dicera divaricata*), hundreds of which

ANALYSES OF SOILS OF THE SOUTHERN COAST RANGE SUB-STATION.

	Granite on hardpan. No. 1147.	Gray, silty soil. No. 1126.	Swale Soil. No. 1148.	Black adobe on hill. No. 1123.	Brown adobe. No. 1149.
Coarse materials >0.5 mm diameter	39.5	20.5	15.3	20.00	13.52
Fine earth	60.5	79.5	84.7	80.00	86.48
<i>Analysis of Fine Earth.</i>					
Insoluble matter	85.12	87.26	81.79	55.43	57.69
Soluble silica	5.57	5.19	8.52	17.95	20.98
Potash .....	.68	.40	.60	.77	.70
Soda .....	.31	.35	.27	.64	.18
Lime .....	.34	.26	.41	.97	1.09
Magnesia .....	.37	.32	.45	1.03	1.04
Br. ox. of manganese .....	.04	.03	.04	.05	.04
Peroxide of Iron	3.83	1.68	3.26	3.43	4.39
Alumina	1.74	2.93	2.80	5.99	9.16
Phosphoric acid .....	.07	.02	.06	.44	.08
Sulphuric acid .....	.03	.05	.01	.07	.01
Carbonic acid	2.19	1.86	2.12	3.25	4.67
Water and organic matter	100.29	100.35	100.33	100.27	100.03
Total					
Humus .....	.66	.55	1.16	1.25	.47
Ash .....	.79	.86	1.28	.47	.21
Available phos. acid .....	.....	.02	.....	.05	.03
Silica .....	.....	.....	.....	.....	.....
Hygroscopic moisture	1.84	2.50	3.43	10.22	11.14
(absorbed at 15° C.)					

were destroyed by a sharp wire or cut from the trunks; and to gummosis which in a few years showed on the cherries and plums.

Apples.—In 1890 these grew well. In 1891 a few kinds began to bear fruit of good quality, and the apple was considered at home here. In 1892 and 1893 some trees showed stunted growth (*i. e.* had reached hardpan). By 1893 some root-knot showed on a number of trees. Those apples which were five years old in a few cases covered a circle of seven feet in diameter with their branches and were seven or eight feet high.

Pears.—In 1891 an avenue of pears was planted where the figs had failed on account of frost. The pears grew very well on the heavier soils. By 1893, the largest pear trees were over ten feet high and each covered a circle of seven feet in diameter. There were eighty-six grafted trees (60 varieties) and twenty-five Japanese seedlings. Pears on the granitic soil were poor.

Almonds.—These made excellent growth during these four years, considering the soil. In 1891 five varieties bore; three were frosted. Other almond crops along the Salinas escaped. There were well-founded hopes of developing an almond industry, particularly in the Santa Lucia range west of the river. In 1892 and 1893 the almonds bore well, excepting Commercial, which was frosted. The heaviest crop was ten pounds per tree. The quality of the nuts was excellent. Ten varieties were in bearing by 1893.

Cherries.—The growth of these trees was weaker by 1890, and by 1891 the trunks of the trees were badly cracked by sun-burn. By 1892 it was evident that the extreme dryness of the atmosphere and the light rainfall rendered this district unfit for the cherry. In 1893 the largest tree was seven feet in spread of branches, but most of them (then over four years planted) were but five feet across. Forty-one varieties were represented, eight of which bore in 1893. The crops were small and the trees unhealthy.

Apricots.—In 1890, these trees continued to thrive better on the light granitic than on the heavier soils. They died in many cases in the swale. The plum stock proved poor and stunted; the apricot stock was better. In 1891 very uneven growth of all the apricots was noted and some branches died back. By 1893 the largest tree spread over a circle of ten feet in diameter. The trees on hardpan had begun to suffer seriously. Eight of the eleven varieties of bearing age first yielded small crops in 1893.

Peaches and Nectarines.—In 1890 some trees bore fruit. Those on plum stock were stunted and poor. In 1891 forty varieties bore from one to fifty pounds of excellent fruit per tree. Twenty-one varieties

had their blossoms frosted. There were heavy frosts in January, February, March, and April. The prospects for successful peach and nectarine culture appeared very bright in 1892-4, when out of seventy-three varieties of peach and nine of nectarines, nearly all bore crops ranging from eight to 100 pounds per tree. Thirty seedlings were also coming into bearing. The blossoming and ripening periods of the different varieties of peaches and nectarines showed very considerable variations from the normal times in other districts, and in relation to each other. As the roots, about 1893, began to reach hardpan, the blossom periods and ripening periods of all these stone fruits became irregular and abnormal. This was more noticeable with these fruits than with plums or cherries, apples or pears.

Plums and Prunes.—The growth of these trees was greatly improved in 1890 by the partial draining of the swale. The Japanese plums did well, Botan doing best, but all promising success. In 1892 and 1893 the plums on hardpan began to fail. The yield per tree on better soil was from six to forty pounds. The European plums began to bear quite well, but the Japanese varieties continued to be valuable. The prunes did but poorly. The best five varieties of plums were Botan, Burbank, Kelsey, Imperial Gage, and Rivers' Early Prolific. Five-year-old-trees covered a circle of six feet in diameter. Myrobalan seedlings were eight feet across.

Quinces.—The quinces suffered much from the dry atmosphere and the poor soil, and had nearly ceased growth by 1893. The few fruits borne were very small and worthless.

Figs.—In 1890 the figs were badly frozen in the swale, but trees higher up escaped. In 1891 and 1892 the trees were again frozen, and to the ground. A few varieties by 1893 seemed to have recovered partially. Angelique, Black Bourjasotte, and White Ischia bore some fruit at the main-crop season. More figs were planted on higher ground.

Olives.—The olives made an excellent start, most varieties growing well till the spring of 1894. Atroviolacea was particularly hardy. Nevadillo Blanco proved too tender. Oblonga, Rubra, and Pendulina bore fruit in 1892. It appeared evident, however, that with care in selection of varieties and location, the olive would thrive in this district as the growth of all the hardier sorts between 1889 and 1893 was satisfactory, considering the lightness of the soil.

Walnuts, Chestnuts, Pecans, etc.—Of nine varieties of walnuts planted in 1889, only three, and those very poor specimens, were left in 1893. The collection of chestnuts was equally a failure. One pecan tree remained, but was worthless and soon perished.

A collection of Japanese persimmons proved entirely unsuited to this locality.

A large collection of mulberries was planted in 1889 and nearly all thrived for a few years, making strong trees covering circles fifteen feet in diameter by 1893. Nagasaki was the best grower, with Alba and Russian nearly as good.

Grapes.—The large vineyard, containing all the leading varieties of table and wine grapes, grew and bore quite well for about three years until the roots reached hardpan. Many small vineyards were planted in the district, and appeared to prosper on similar soil. The vineyards elsewhere receive notice in subsequent paragraphs. So well did the vineyard grow, and such excellent fruit did it produce between 1890 and 1894 that the late Adolph Sutro, who visited the sub-station in 1893, regretted his failure to buy one of the big ranches east of the river and plant it all out in wine grapes.

Conclusions.—To sum up this period of four years, the sub-station had reason by the winter of 1893-4 to believe that with care, apples, pears, Japanese and some other plums, peaches and nectarines, olives and mulberries as well as grapes would succeed here. The temporary success of the almond it did not seem reasonable to expect would continue, but hopes for the other fruits, together with all the inferences therefrom, appeared justifiable.

ORCHARD HISTORY, 1894-1900.

In the winter of 1893-4 the entire district suffered from drought. The tree-roots of this particular orchard had now reached hardpan wherever such soil underlaid the surface within two or three feet, and had spread widely out upon that hardpan. The trees in some cases were also beginning to bear; in others were approaching a full bearing age. The total rainfall at the sub-station from October, 1893, to July 1st, 1894, was 5.70 inches, accompanied in spring by drying winds and severe frosts. The actual rainfall of value to crops, not mere scattering showers in May and June, was but 3.68 inches. Thorough cultivation and pruning maintained the entire orchard alive, and some growth was made.

From this season, however, dates the beginning of the destruction of that part of this deciduous fruit orchard which was planted on the granite soil underlaid by hardpan, and the accompanying illustrations show clearly the nature and effect of the root difficulty. The rainfall of 1895-6 was 13.14 inches, but the season was windy and frosty, so that the orchard again suffered. In 1896-7 there was an excellent

season with nearly 18 inches of rain, but 1897-98 was one of the worst on record, the rainfall being but 4.75, and badly distributed.

Apples.—Some growth was made on one-third of the trees. No fruit was yielded in 1894 or 1898. The crop of 1895 ranged from five to sixty pounds a tree and 27 varieties bore. In 1897 and 1899 the crop on about as many varieties ranged from five to forty pounds a tree. The fruit was small and poor, and lacked juice. The apples now showed, as had the peaches in former years, great variations in dates of blossoming and of ripening fruit. There were no winter apples here, all the late keepers of other districts ripening before November 1st.

Pears.—The holding power of these trees, which were, however, as a rule on heavier soil, was very satisfactory. In 1894 the Japanese seedlings bore fruit; in 1895 eight European varieties bore; in 1896 the crop was small, owing to late frosts; in 1897, 21 varieties bore from one to fifty pounds per tree; in 1898 and subsequent years the pears did very well. Many varieties showed remarkable variations in times of ripening from those observed in other parts of California. The quality of the pears grown on all soils here was very high. On hardpan the fruit was small and knotty, but still of good flavor; on the heavier soil of the swale and beyond, it was of great excellence. The largest tree was fourteen feet high.

Almonds.—The largest almond tree, by 1900, was sixteen feet high, and ten feet in spread of branches, with a trunk diameter of ten inches (variety IXL; age twelve years). The photograph (Plate 1)



PLATE 1
ALMOND ORCHARD

shows the almond orchard as it appeared in 1900. Another photograph (Plate 2) shows the root system of one of the almonds, a twelve-



PLATE 2
ALMOND ROOTS ON HARDPAN

year-old seedling, illustrating the extent to which even the almond was forced to grow on the surface. Yet, as the photograph shows, some roots in the center really succeeded in penetrating the hardpan. These central roots were unable to pierce clear through to the substrata, but they helped to maintain the tree. During this whole period—1894–1900—the almond crop was practically a failure, owing to frosts. The almond did not prove profitable anywhere in this district; many orchards, even west of the river, in the foot-hills, were removed.

Cherries.—There was no yield worth mentioning during this period. The trees suffered more than ever from gummosis. The few fruits were of excellent quality. Mahalebs did little better than Mazzards, bearing more, but suffering as much from the unsuitable soil and climate. The late frosts destroyed most of the blossoms.

Apricots.—All varieties practically lost their entire crops from the late frosts; a few apricots ripened in 1897 and 1899. The ordinary varieties of commerce are useless here, and the only chance of success lies in the hardier but less valuable Russian and half-wild types. All the apricots on hardpan succumbed.

A typical apricot tree on hardpan is shown in the illustration (Plate 3). The variety is Smith's Triumph, ten years planted, height ten feet. This was the best apricot tree on this soil. During its entire life it has not yielded ten pounds of fruit. The root system of an adjoining tree of the same age and variety is also shown (Plate 4) and it illustrates the entire lack of penetrating power of the roots.



PLATE 3
APRICOT TREE ON HARDPAN



PLATE 4
ROOT SYSTEM OF APRICOT ON HARDPAN

The area of soil drawn upon by these apricot roots above the hardpan was less than 475 cubic feet. They seemed to lose their power of extension beyond seven or eight feet from the base of the tree. In a normal orchard with a deep soil the roots of an apricot tree may spread through upwards of 2000 cubic feet.

Peaches and Nectarines.—All additions made were of the hardier sorts. The trees on hardpan failed rapidly and the greater part were removed. In 1894, 1896, 1897, and 1898 the crop was practically destroyed by frost. In 1895 forty-one varieties bore well and twenty-five lost their crops. There was never much curl-leaf here. The trees on all soils showed gummosis, and much root-knot. On the hardpan they became very unhealthy, portions of the branches died back, and they blossomed and leaved out at irregular intervals. The nectarines appeared to withstand adverse conditions a little longer than the peaches. The best peaches as regards size and quality were the very early half-clings, such as Briggs's May; the later peaches lacked juice and size. There was quite a crop in 1897 of peaches and nectarines.

The peach is a very important fruit in this district and gives great satisfaction in many places west of the river. East of the river, on good soil, peach trees bear perhaps two years out of three, and in sheltered locations may do better. The accompanying illustration (Plate 5) of peaches and nectarines on hardpan shows plainly the



PLATE 5
PEACH AND NECTARINE ORCHARD ON HARDPAN

failure of these trees under such conditions. Such trees were no larger at twelve years of age than they had been at three—and bore less fruit. They never paid for cultivation. The photograph of the root system (Plate 7, page 17) still further illustrates the trouble. The Sellers' Cling in the picture was cut back in the drought year of 1894 and had to be protected against sunburn. All of nearly a hundred peach and nectarine trees taken out showed trunks and roots similar to those of this Sellers' Cling. The renewal of the tops was very fair, but many trees showed immense crown knots, as shown in the illustration (Plate 6).



PLATE 6
CROWN KNOT ON PEACH

Plums and Prunes.—During this period the plums and prunes, which were nearly all on hardpan, failed badly and many were taken out. The late frosts destroyed both the European and the Japanese plums in 1894 and 1896, and the Japanese in 1895 also. In 1897 and

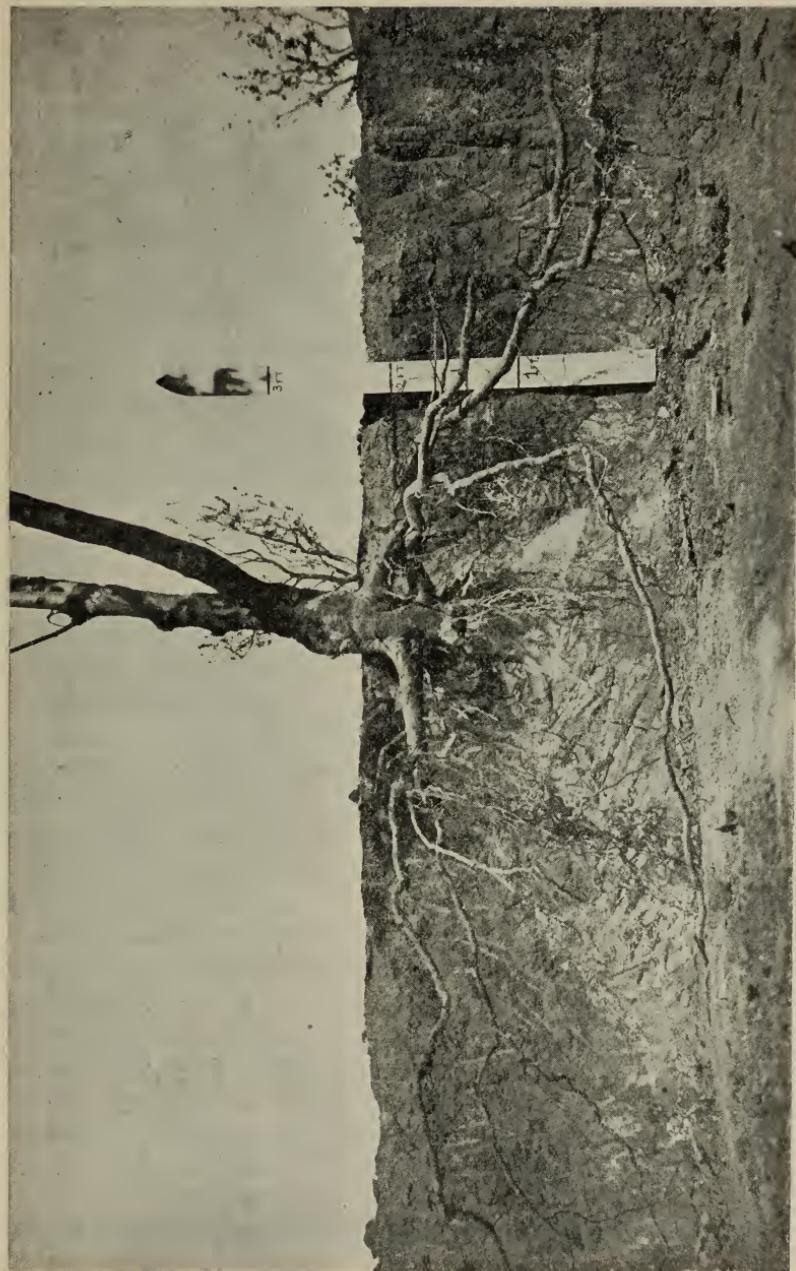


PLATE 7
PEACH TREE ON HARD PAN

1898 the Japanese types again did better than for several years previous. Burbank, Kelsey, Botankio, and Imperial Gage did very well. The new American plums, such as Milton and Hammer, withstood the late frosts. The Myrobalan bore nearly every year.



PLATE 8
PRUNE TREE

The plum roots made no more descent into the hardpan than did the peach, and suffered more from the heat of the surface of the soil. The illustrations of typical prunes are from among the best trees, except the Myrobalan. Many of the plums at twelve years of age were no larger than the seven-year-old Petite prune d'Agen, illustrated in Plate 8. The leaves of the plums fell from the twigs in early autumn; in years of greatest drought the trees lost half their foliage



PLATE 9
OLIVE TREE

by midsummer, suffering in this respect more than the peaches, but not more than the apricots and cherries. Abnormal developments of numerous buds along the twigs especially marked the deterioration of the plums and prunes on hardpan soil.

Olives.—This period saw the definite abandonment of olives as a crop, new wood having been much injured by frost on all varieties for four successive seasons. The Redding Picholine bore small crops, and Oblonga, Corregiolo, and Praecox yielded a little. The trees almost ceased to grow, and the crop evidently had no commercial place in the locality.

One olive tree on the sub-station, Corregiolo, has reached a height of nine feet and a spread of five, but is not upon the worst hardpan. This tree was two years old when sent here in 1889. No other olive on the tract is more than one half as tall, and many are mere clumps of frost-bitten growth. Corregiolo, here illustrated (Plate 9), and Redding Picholine have been the hardiest. Plate 10 shows its root system on medium hardpan.



PLATE 10
OLIVE ROOTS ON HARDPAN

Grapes.—Three-fourths of the vineyard has been removed because of its ceasing to grow or to yield a crop on the hardpan soil. The roots of the grapes, while penetrating a little, in no case passed through the hardpan. The vines were consequently stunted, extremely

susceptible to spring and early winter frosts, and a mass of knots, as shown in the photograph (Plate 11). The fruit was small and poor.



PLATE 11
GRAPE-VINE KNOTS ON HARDPAN

In no cases did a vine yield more than from five to ten pounds of fruit after 1896. On the more shallow soils, crops of two and three pounds to the vine were the average. Blasting and boring through the hardpan seemed to give some little aid to the grape-vine roots.

The vineyard, left after the removals of 1900 and 1901, contains nearly all the varieties originally planted and extends along the eastern side of the tract.

Other Fruits.—A few remaining figs that had escaped the late frosts bore a little. In 1897, Agen ripened fifteen pounds September 25th. A few others ripened some fruits before the early winter frosts came. In 1898 the trees were killed to the ground and removed.

Mulberries in these years usually lost the first crop of leaves, but the Persian did not. They continued to thrive on very poor and shallow soil. Alba, Lhoo, and Nagasaki bore large crops, and are valuable for poultry or swine. The Persian bore well, and is a

valuable crop for domestic uses. Mulberries ripen here ten days later than at Shasta, which is 350 miles further north.

Chestnuts, English Walnuts and Japanese Persimmons succumbed. A California black walnut slowly penetrated the hardpan, held its own and continued healthy.

CONCLUSIONS.

During this period of six years, to the close of 1900, it was clearly shown, entirely aside from any soil question, that the climate forbids the successful culture of most deciduous fruits at the sub-station. Pears, apples, certain plums, a few peaches, and mulberries were all that gave continued promise of success here.

Aside from problems of climate, the granitic soil, on hardpan or otherwise, was soon exhausted and needed more moisture than the average rainfall to keep the trees in health. The hardpan soil was unfit for fruit culture. In order to remedy the difficulty as far as possible, holes were bored through the hardpan beneath selected trees. Close to other chosen trees, holes were blasted. The extreme thickness of the hardpan militated against success in these efforts, and of fifty trees of all sorts of deciduous trees thus treated, none, when removed several years later, showed growth down these channels. The soil was heavily fertilized on a portion of the orchard; another portion was sown to European lupins for plowing under, but the plants grew only three or four inches high. The only plant which thrived in this orchard on hardpan soil and penetrated the hardpan was *Atriplex semibaccata* (Australian salt-bush).

The total number of trees planted between 1889 and 1897 on the hardpan part of the orchard, south of the swale, including all re-plantings, had been 455, on about two and a half acres of ground. It became necessary to remove for failure, because of soil or climate or both, 360 of these trees by December, 1898, leaving less than a hundred scattered specimens for further study.

TYPICAL REPORTS BY VARIETIES.

The following brief tabular reports show the behavior of different varieties of deciduous fruits in 1899 and 1900 and still further emphasize the poor condition of the orchard on the hardpan soil.

ALMONDS ON HARDPAN.

Variety.	Year.	First flower.	First leaf.	Crop ripe.	Am't. in lbs.
King's Softshell	1899	Feb. 19	Feb. 24	.....	none
"	1900	Feb. 3	Feb. 15	Aug. 4	4
I.X.L.	1899	Feb. 13	Feb. 22	.....	none
"	1900	Jan. 26	Feb. 3	Aug. 4	7
Prolific	1899	no bloom	Feb. 27	.....	none
"	1900	Mar. 2	Feb. 26	.....	none
Pistache	1899	Feb. 21	Mar. 3	Aug. 31	a few nuts
"	1900	Feb. 12	Feb. 28	.....	none
Texas Prolific	1899	Feb. 27	Feb. 21	.....	none
"	1900	Feb. 20	Feb. 23	.....	none
Bidwell's Mammoth	1899	Feb. 17	Feb. 20	.....	none
"	1900	Jan. 26	Feb. 5	.....	a few nuts
Marie Duprey	1899	Feb. 13	Feb. 28	.....	none
"	1900	Jan. 24	Feb. 18	.....	a few nuts
Golden State	1899	no bloom	Feb. 21	.....	none
"	1900	Feb. 24	Feb. 19	.....	none
Languedoc	1899	Feb. 24	Feb. 24	.....	none
"	1900	Feb. 13	Feb. 25	.....	none
Drake's Seedling	1899	Feb. 24	Feb. 21	.....	none
"	1900	Feb. 12	Feb. 20	.....	none

Crop of 1899 destroyed by frost of April 23, 1899.

Crop of 1900 destroyed by frost of April 9 and 10, 1900.

So small an almond crop was practically of no value, and only showed that a few late flowers escaped frost.

The following sixteen varieties of apricot blossomed in 1899 and 1900, between March 1st and April 20th: Luizet, Newcastle, Peach, Turkey, Moorpark, Smith's Triumph, Orange, Alberge de Montgamet, Pringle, Purple, Large Early Montgamet, Royal, Blenheim, Routier, Beauge, Kaisha. The fruit of all was destroyed by frost.

The plums blossomed variously from March 1st to April 21st. Out of thirty-seven varieties remaining on the hardpan soil in 1899, only Blue Damson, Coe's Golden Drop, Oullin's Golden, Imperial Gage, Columbia, and Kelsey bore a few plums. All were stunted, diseased and dying trees.

The remaining apples on the hardpan held out longer than some other fruits, as the following table shows:

APPLES ON HARDPAN.

Variety.	Year.	First flower.	First leaf.	Crop ripe.	Am't. in lbs.
Keswick Codlin	1899	Mar. 30	Apr. 4	Aug. 15	48
"	1900	Mar. 28	Mar. 20	.....	none
Eng. Gold. Russet	1899	Mar. 25	Mar. 12	Sept. 12	24
"	1900	Mar. 24	Mar. 10	.....	none
Missouri Pippin	1899	Mar. 30	Apr. 3	.....	a few apples
"	1900	no bloom	Mar. 20	.....	none
Fall Pippin	1899	Mar. 25	Mar. 30	Aug. 23	39
"	1900	Mar. 24	Mar. 12	.....	none
Ben Davis	1899	Mar. 25	Mar. 30	.....	a few apples
"	1900	Mar. 20	Mar. 21	.....	none

PEACHES ON HARD-PAN.

None of 69 varieties of peaches that remained in 1899 and 1900 bore at all, since the April frosts destroyed the crops in both seasons. One nectarine, Victoria, escaped these late frosts and bore fifty-eight pounds of fruit. The bloom period of the peaches and nectarines was from February 20th to the middle of March, varying according to variety.

A NEW ORCHARD PLANTED.

In 1894 the old orchard of pears, apples, and other hardy fruits was extended north from the swale on the west side. In 1897 a large extension was made, consisting of apple and pear trees which had been grafted on the best obtainable stock to all the promising new varieties of which scions could be procured. These came from Europe, Canada, British Columbia, Australia, and many other places. Some were seedlings of note collected in Oregon and California.

Object of this orchard.—The three-acre new orchard thus established in 1897 was expected to show three things: (1) that upon this deep soil, free from hardpan, a healthy bearing orchard could be maintained with proper cultivation even in this region of fluctuating rainfall; (2) that the quality of the apples in particular was higher than on trees on the lighter soils; (3) that by careful selection of hardy fruits, much greater certainty of crops could be secured. After four years' experience with this orchard, all these results appear in a fair course of attainment. The trees are healthy; the few that have borne had fruit of excellent quality, and the Canadian, Swedish, Russian, and Scottish apples, as well as nearly all the pears, promise hardiness.

In addition to apples and pears, the young orchard contains many hardy cherries and plums, but these do not thrive as well as the pome fruits, owing to the extreme summer heats. Quinces and medlars have done very well indeed.

Views in the young orchard. One illustration (Plate 12) presented shows a Beurré Golden de Bilbao pear, one of several rows of like character on the dark adobe soil of the northeast corner of the tract. This would be thought a good tree in almost any orchard. It was one year old in nursery when removed, and had been four years in the orchard when photographed; head low, pruning severe, cultivation first class.

Another photograph (Plate 13, page 26) shows a view in the young apple orchard of the same age and treatment as the pears above noted, and other photographs show the largest apple and pear trees (Plate 14, page 27) left on the swale soil from the original orchard planted in 1889. But the black adobe is a better soil for these fruits than is the swale.



PLATE 12
PEAR TREE ON ADOBE SOIL

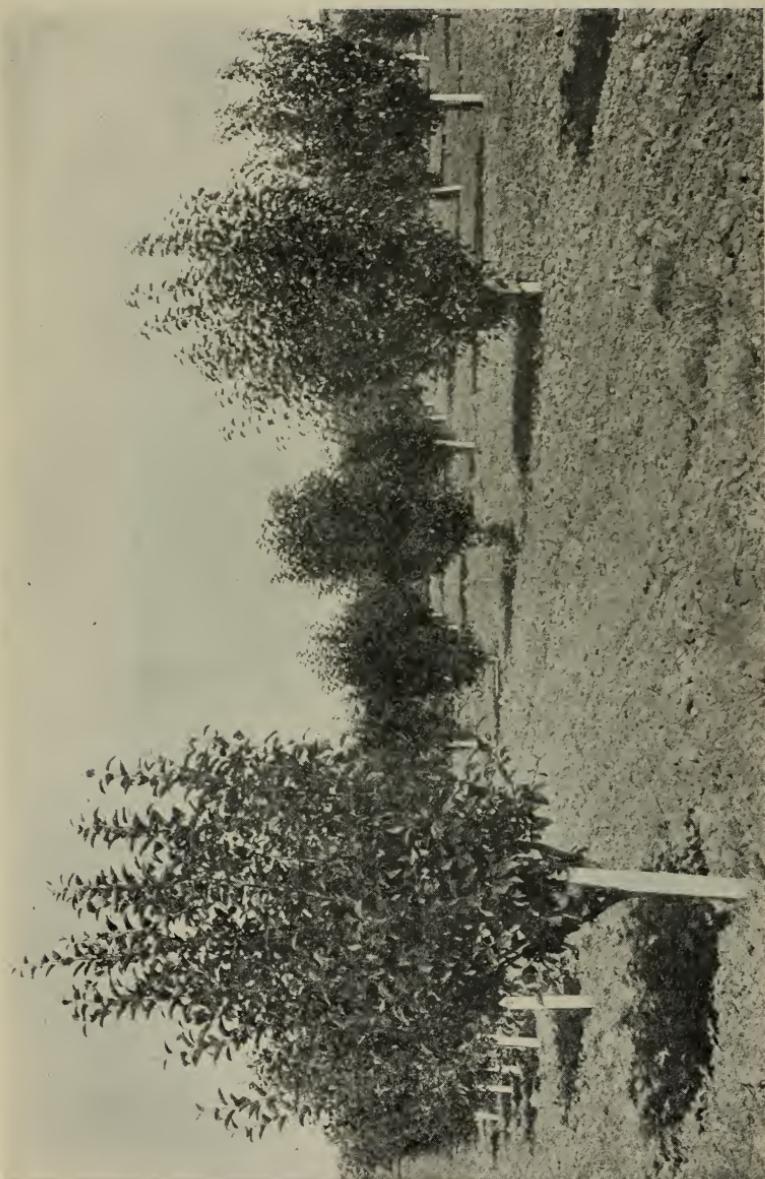


PLATE 13 (See page 24)
YOUNG APPLE ORCHARD ON SWALE SOIL.



PLATE 14 (See page 24)

APPLE TREE

PEAR TREE

VISITS TO OTHER ORCHARDS.

The failure of so many deciduous fruits on the hardpan soil of the southern end of the station tract may be said to determine the entire unfitness of such soil for tree culture. Previous blasting and boring where such granitic hardpan is so thick will not avail, because in the course of time the hardpan is re-formed. The soil is entirely unsuitable for the growth of fruit trees, although, as the station experience has amply shown, oaks, mulberries, cork-bark elms, and a few other trees can establish themselves here.

But there are localities in this entire region, even east of the Salinas, where no hardpan exists, or where it is comparatively shallow and more easily penetrated, in which places orchards have done better. Some of these locations are less frosty than the sub-station tract,

which makes a great difference in the growth of trees and yield of crops.

The foreman, Mr. J. H. Barber, spent a good deal of time in 1900 visiting and reporting upon orchards. At various times, when at the sub-station, I also went to see these orchards and examined the conditions which had favored or hindered them. The result of these investigations over a wide area was to confirm in the main the experience of the sub-station in respect to deciduous fruits. It is to be noted that the effort was made to hunt up those persons who were reputed to have *good* orchards and vineyards. No attempt was made to observe the utter and generally recognized failures, of which many exist. The notes which follow may, therefore, be understood as representing a fair and full statement of the best that can be said for deciduous fruit culture in this region east of the Salinas, upon soils sometimes better than the hardpan but no better than the adobe of the sub-station, and sometimes, but not always, in less frosty locations.

The Kilshaw orchard.—This place is three miles east of the sub-station, on a low hill among rolling hills, an excellent situation. The granite soil has some hardpan. Here were planted in 1893 250 almonds, Ne Plus Ultra, I.X.L. and Nonpareil, all on peach; and 250 French prunes on Myrobalan; earlier in 1890 a mixed orchard of nearly 500 apricots, peaches, plums, pears, apples, olives, etc., was planted. The trees have made poor growth, but in 1900 appeared healthy, except some of the older trees, which were reaching the hardpan or exhausting the soil. All the above trees bore well for the size of the trees and the lightness of the soil; frosts are not severe here. The almonds were the only profitable crop. These trees were well planted, 20 feet apart, well cultivated, pruned and cared for.

The Farington Orchard.—This orchard is near to Mr. Kilshaw's. One acre was planted in 1890, seven acres in 1891 and seven acres in 1892. All kinds of deciduous fruits are represented. The soil is a light, sandy loam for the peaches, a good, strong adobe for the others; no hardpan anywhere. Cultivation has been fairly good.

Plums died; prunes do well on adobe; nectarines crack open; pears are excellent—700 Bartletts now bearing; apples do quite well; almonds are not frosted. But the orchard does not pay, the pears coming nearest to a profit. The birds destroy much fruit, and the trees sunburn. A large part of the orchard has been taken out.

Iver Iverson's Orchard.—This quite noted place is on the Estrella plains. One thousand French prunes were planted, also 200 apples, in 1892. The mixed orchard then planted has been taken out. The soil is a strong adobe, with a chalky gray sub-soil.

Mr. Iverson's prunes have never paid, as the fruit is too small, and the hot weather sometimes "cooks them on the trees." The stock is Myrobalan, but Mr. Iverson's observations lead him to prefer almond, which he thinks stands drought better. Irrigation from deep wells, with engine, costs too much for this kind of an orchard. He expects to take the prunes out unless a very wet season gives them a start. The apples are fine, healthy trees, and large for the district. Astrachan, White Winter Pearmain and Yellow Newtown Pippin bore well in 1899 and 1900. "Quality was fair, but not equal to that of the coast apples" (that is, apples grown farther west, in the Santa Lucias, on San Simeon Creek, etc.). A few trees of the Kelsey Plum (Japanese) bore very well. One fig tree is in bearing. None of the above fruits paid expenses, even for the local market.

Mr. Iverson planted 2000 grapes on this soil and found them profitable. He makes wine and sells table grapes. The Zinfandel shows black-knot; other varieties are free from it. Cultivation of both orchard and vineyard is with a weed-cutter; no plowing is done.

The Gordanier Orchard.—The well-known old orchard of Mr. Irving Gordanier is beautifully situated on the south bank of the Estrella River, between San Miguel and the town of Estrella. The soil is a sandy and gravelly loam, with no hardpan.

Twenty-five acres were planted to deciduous fruits in 1885; ten or twelve acres have been grubbed out, and more will follow. The leading fruits remaining are apricots (Royal and Moorpark), peaches (the leading commercial varieties), apples (Astrachan, Bellflower, etc.), pears (Bartlett, Winter Nelis, etc.), and prunes, French. The plums and cherries were an entire failure. This orchard was headed high and the trunks suffered heavily from sunburn, the cause of the loss of the cherries and plums. Frost often destroys the crop; since 1895 only one good crop (excepting of pears) has been obtained. When the trees were young the crop was of good size, but is now small, due to the lightness of the soil and lack of moisture. Cultivation has been fair, all weeds being kept down and the trees being pruned, but nothing more.

There has been "no profit on this orchard in any year." No fruit has paid for the labor and interest on the cost of the land, because of "frost, drought, and sunburn."

Jed. Mills's Orchard.—This is situated near the Gordanier orchard, on sandy upland. Fifteen acres of deciduous orchard here "did not pay," and thirteen acres were grubbed out. Late peaches do not mature by reason of the lack of moisture; early peaches do better: prunes failed. Pears have died from leaf-blight. In 1897, when the

trees had been five years planted, there was a good crop of apricots, peaches, pears, and almonds, but almonds are generally frosted. Culture was fair.

This orchard has been only a source of expense. Trees failed as soon as they began to bear, and Mr. Mills thinks there is nothing in fruit for this region, excepting as a small family orchard to which sufficient water can be applied by irrigation. As there are few such localities, he practically discourages all orchard planting. His vineyard of one and a half acres, set in 1888, was frozen twice, but the vines recovered and now yield well. There is, however, no market against the shipments from outside grape districts, and "the only value of a vineyard is for home use."

The Proctor Orchard.—Mr. G. E. Proctor, two miles southeast of San Miguel, has twenty-five acres in fruit, chiefly prunes, but including all deciduous kinds and planted in 1892, 1893 and 1894. The prunes have been "about a quarter crop"; the almonds have suffered some from frost. The whole orchard has been injured by drought, and now it receives little care; it has proved unprofitable and fruit is too poor to ship to any market. Some hardpan occurs here. This orchard was planted in the very dry year of 1894, and is now failing.

Kirkpatrick Orchard.—This pioneer orchard is situated in Ranchito Cañon, east of San Miguel. Here Mr. R. R. Kirkpatrick in 1884 planted four acres of orchard and vineyard, and about twelve acres more in 1886, 1887, and 1892. The last plantation (of four acres) is all that remains. The soil is adobe with some gravel. Trees were set twenty-five feet apart. "In wet years crops were good". Frost has caused partial but not entire loss. Growth of trees was checked in every dry year, and therefore the orchard did not pay at all. At first the apples were very good, but as the tree aged, the fruit became small, dry and insipid. The same fact was noted with peaches, apricots, and nectarines. German prunes "were excellent for a few crops", then failed. English walnuts grew well only in wet years, but were often hurt by frost. A fig tree ten years old bore every year. Morello cherries at first grew very well; then suffered from drought and sunburn, died back and were grubbed out.

The culture of this orchard was excellent for some years. The fruit "never began to pay expenses." This orchard, like the two next described, is in the foothills east of San Miguel, but not on the Estrella Plain.

The Fowler Orchard.—Here fifteen acres were planted in 1884 and soon after, and ten acres have been grubbed out. History of the place is much like that of Kirkpatrick's. Nectarines did better than peaches;

"summer varieties of apples are good"; all the pears do well if deeply cultivated and headed very low; almonds were frosted or taken by birds. The chief drawback is lack of moisture, and the orchard "does not pay expenses."

The Faulkner Orchard.—Ten acres were planted in 1886 by Mrs. Faulkner in Ranchito Cañon, and were grubbed out in 1898 as unprofitable. Walnuts, chestnuts, and figs as well as apples, peaches, etc., were tried here. As soon as the trees were old enough to bear, they died back. The cause was drought and hardpan. The orchard received thorough cultivation. Two thousand rooted grape-vines and twenty thousand cuttings were planted here in March, 1888, but were killed by the northerers and drought of that spring.

The Malmberg Orchard.—This is in the Linne settlement near the Huerhuero, where a number of hard-working farmers have homes. Mr. E. Malmberg planted about eight acres in 1895, and added some olives in 1897. The soil is a sandy loam with chalky sub-soil, on a slope. The growth so far is good; the trees are healthy and well cared for. The fruit is small (not well thinned). Olives and almonds so far are not injured by frosts. Trees show need of more moisture. Profit is very doubtful. Three acres are of muscat grapes; but the fruit was too small and dry for good raisins, so the vines were grubbed out.

Orchards of Geneseo Settlement.—This is a settlement of farmers, mostly Germans, about five miles north of Creston. They came here about 1885. There are no cöoperative features, but they have much social and religious unity. The Ernst Brothers and others came from Geneseo, Illinois—hence the name.

Between 1886 and 1890, these farmers planted a number of small orchards and vineyards. Everyone was then very hopeful of the future of this industry. Droughts, late frosts, and various discouragement have caused all or nearly all to lessen their orchards materially, but they have retained their vineyards, and a few have been enlarged. The records stands as follows: Wm. Ernst planted five acres of orchard and seven acres of grapes; took out three acres of orchard. John Ernst planted ten acres of orchard and nine acres of grapes; took out all his orchard. Martin Ernst planted six acres of orchard and ten acres of vines; took out four acres of orchard. Mr. Klaus (pastor of the little Lutheran congregation) planted, on the two acres of the church property, an orchard and vineyard which remain. G. Clingworth planted two acres of orchard and six acres of vines; added four acres of vines. Jacob Timkin planted ten acres of orchard and four acres of vines; took out seven acres of orchard. Charles Pepmiller planted seven

acres of orchard and three acres of vines; took out four acres of orchard, J. Schlegel, M. Holziner, George Boneker and Fred Hirt planted in all thirty-three acres of orchard and vineyard, all of which still remain.

A more detailed account of several of the above orchards and vineyards was furnished by the settlers themselves. John Ernst, whose ten acres of prunes, small family orchard and ten acres of vines were planted in 1886 on the rich bottom land of the Huerhuero River, found in a few years that "the trees did not pay expenses." His vineyard of Mataro, Carignane, Burger, Rose of Peru, and other varieties, is profitable, as he makes wine for the local market.

David Paulus planted his orchard on light, sandy and gravelly loam, in 1889, the same year the station was established. He replanted where trees failed and regrafted many sorts. His apples and pears were on heavier soil and have done fairly well. The spring frosts have often destroyed the stone fruits. There is also "too little rainfall and the fruit is poor in quality as well as small." The orchard has always been unprofitable, though receiving excellent culture. The Burger grape is least subject to frost, but suffers from mildew.

Results at Geneseo Settlement.—Mr. William Ernst, who furnished much assistance in collecting and revising the data relating to this interesting group of orchards and vineyards, and who is thoroughly familiar with the history of them all, notes that, as at the sub-station, deciduous fruits of every kind grew well for a few years. The winters were more rainy and less frosty than some which followed, and the soil was new. The farmers felt much encouraged and thought they had a "first class fruit country." In 1890 four dollars profit was made from each early-bearing peach tree in some of these orchards. The cherries which bore in 1890 and 1891 also paid very well. Prizes were taken at county fairs for peaches, cherries, Japanese plums, pears, and grapes grown in the Geneseo district, and this was in competition with Arroyo Grande, one of the most famous valleys of San Luis Obispo county.

Then, as occurred at the sub-station, though the Geneseo settlers had a much better soil, usually free from hardpan, the trees commenced to fail in the dry years, could not recover, were grubbed out by the acre, and though a few orchards have been kept, in the hope for better times, the industry is practically abandoned and the remaining orchards are very poor. Mr. Klingworthy, whose location is less frosty, retains one of the best orchards here.

The local market has proved almost worthless, as "in good seasons everyone has fruit, and in poor ones there is none to sell." The long hauls to the railroads and high freights would prevent shipment of

fresh fruit even if it were first rate in size and quality, which it can seldom be under these conditions. There has not been enough fruit to dry or can successfully for market, and the spasmodic crops forbid investment in the necessary "plants" for handling it. The farmers have come to depend upon grain and livestock with perhaps a small vineyard and a few fruit trees. No orchards are being planted by newcomers, and the few old orchards remaining are sadly neglected. The entire community feels assured of the unprofitableness of deciduous fruits here.

The feeling in regard to grapes is quite hopeful. Considerable wine is made for home use and local sale. It is in demand in Paso Robles and other towns where its use is said to be increasing. The grapes are high in sugar contents and the vines bear every year, and generally a good crop.

ORCHARDS NEAR CRESTON.

Experience of J. V. Webster.—One of the most famous and best kept of the early orchards east of the Salinas was that of the Hon. J. V. Webster, who deeded the land for the sub-station and was for a number of years the Patron, or local trustee. Mr. Webster planted quite an orchard in 1887 on his home place near Creston. The soil is a decomposed granite. The orchard contained eight acres of apricots, and some peaches, apples, etc. Trees grew well until 1891; then the frosts cut back the apricots in spring and the trees died, a few at a time, until all were gone. The entire orchard during its whole life "bore not more than a bushel or two of fruit." Peaches were started too high, so they sunburned and died. Frost, heat and drought destroyed them, and in 1900 all remaining were grubbed out. The apples still yield some fruit.

Mr. Webster was formerly a very strong advocate of fruit culture in the upper Salinas, and more particularly in this region, but he now says, "A few trees are all one can afford to keep." His vineyard has been more valuable. Twelve acres planted in 1887—Mataro and Carignane with some table varieties—has always borne well and is profitable for wine. He prunes late, in February. He says, "All the decomposed granite hills about Creston will eventually be covered with fine vineyards, producing wine of first-rate quality."

The Angus Orchard.—Mr. E. Angus, east of Creston, planted in 1891 about eight acres of apricots, peaches, prunes, apples, and pears, and has now cut out about one-half. The fruit has been profitless. Grapes have been satisfactory. The soil is light, loose, and granitic.

The Blake Farm.—This place is situated in the foothills southeast

from Creston, and twenty acres of almonds were planted here in 1889—the largest almond orchard in the region. Since 1894 the orchard has been neglected. It has never paid a profit. The trees still live, though uncultivated for several years. Frost generally kills the crop.

The Ballard Farm.—The following statement made by Mr. E. B. Ballard, whose farm is three miles south of Creston, is especially worth printing just as it was written. The energy and ability of Mr. Ballard are well known in San Luis Obispo County, and if any one could make fruit culture a success here, he would be able to do so. He says: "In 1890 I planted a small family orchard of about 150 trees of the best varieties of apples, pears, prunes, plums, peaches, nectarines, quinces, cherries, and almonds. The said orchard has had good cultivation and fair pruning. The soil is adobe where the prunes, apples, and pears are planted; the other trees are on a more gravelly soil. Hardpan exists from two to three or in some cases four feet from the surface. Fruit crops during the past ten years have been failures, with perhaps the exception of the plums, prunes, and pears (Bartletts). Frost has generally been the greatest curse, but if the peaches did escape they could not be beaten in flavor. I have never tasted a cherry, apricot, quince, or almond grown on the place. I do not think an orchard in this locality profitable either as an investment or for family use, as fruit, when plentiful over the State, can be bought very cheap, and when a failure elsewhere it is safe backing that this locality has not escaped."

SOME ORCHARDS NEAR THE SALINAS.

The Shackelford Orchard.—This very notable orchard is one mile southeast of Paso Robles, east of the river, and here, in 1890, Mr. R. M. Shackelford planted thirty acres of Bartlett pears, 90 acres of French prunes, and 40 acres of Redding Picholine olives. The pears were on a light, sandy loam, 20 to 40 feet above the bed of the Salinas the prunes were on a higher bench, and the olives on the rolling uplands. The culture was excellent for a number of years, but the orchard "never paid expenses, or near it," and has, naturally, been neglected. Frost and drought were the causes of failure. The pears are said to have paid for themselves, and were the most promising crop.

The Van Elliott Orchard.—This is a small, well-kept orchard west of the Salinas, beside the river and within the town limits of Paso Robles. Ten acres, chiefly prunes, were planted in 1887 and 1890. The soil is a gravelly bench land; some is river bottom. Cultivation was careful and thorough for some time, but "spring frosts rendered the orchard unprofitable," and it has not been pruned in recent years. The trees are healthy, but small.

Many small family orchards have been planted in years past on this low bench land, ten or fifteen feet above the Salinas or on the low hills near it, but still west of the river. Few of these trees remain, and little fruit is produced. When it escapes frost it finds ready local sale. Mr. Van Elliott had a few apricots, apples, pears, peaches, but mostly prunes. Experience shows that pear trees promise better than anything else here; large, healthy pear trees are often seen in old and neglected orchards along the Salinas.

The Thomas Orchards.—These lie southeast of Templeton, at the Mount Pleasant Ranch and the Eureka Ranch, and have received excellent care. Mr. A. L. Thomas, who is a prominent farmer of the district, planted four acres of almonds in 1896 which bore well in 1901. He also has sixteen acres of prunes, pears, and other fruits. On the Eureka Ranch, where he owns twenty-five acres of prunes and has charge of forty more acres, there was originally 185 acres of prunes planted and sold with the lands to colonists. About 120 acres are still kept up. The soil is granitic, mostly rolling hill; the fruit is small but very sweet. In the swales between the hills the trees, of course, grow much larger, and often yield better. The crop is frequently destroyed by frost. "None of these prune orchards have been profitable here. The hills are too dry and the lowlands are too frosty."

The Granger Orchard, near Shandon.—Two miles south of Shandon, east of the Salinas, Mr. Granger began to plant an orchard in 1884, and continued until he had forty acres of deciduous fruits. As at the sub-station, the trees did well while young and in years of greater rainfall. But they soon began to fail and the orchard proved profitless, so that thirty-five acres were cut out. Soil is a sandy loam on a stiff yellow clay. Pears "are the only fruit that never failed."

The rainfall at this place since 1884, as kept by Mr. Granger, shows some striking features. In 1884-5 it was 6.48 inches, but the next year it was 23.60 inches and the following year it was below eight inches. In the seventeen years between 1884 and 1901 it twice fell below four inches (in 1893-4 and 1897-8); it rose only eight times above ten inches, and in fact but twice during the whole period was it more than 14 inches. This is evidently not a country for the successful growth of fruits without irrigation.

Another orchard near Shandon is that of Mr. Shedd. Here are two very large fig trees, 32 years old. The orchard of three or four acres was mostly planted before 1880 and was in bearing to some degree in 1884. Almonds and apricots are often destroyed by frosts. Apples and pears bear, and so do the figs—three crops a year. The orchard and vineyard have received a good deal of irrigation by means of wind-

mills. They were formerly profitable, but have been neglected in recent years.

Other Orchards east of the Salinas.—Many orchards not previously noted were looked up in the course of these investigations. One of the numerous failures found unprofitable, neglected, and abandoned is illustrated on page 37 (plate 15). One often sees in the corner of some grain field a few straggling fruit trees and vines.

Some of the orchards not previously described were, however, of a better type. One of these is that of Mr. A. J. Pinkstone, of Keyes Cañon, north of the Estrella. This is especially interesting because he has succeeded quite well with almonds. The place is sheltered in the cañon, and there are thirteen acres in almonds, peaches, apricots, figs, and walnuts.

On the famous ranch of Santa Ysabel, there is a promising young orchard, planted on three benches of land just east of the Salinas in 1890. The soil is a sandy loam, the lowest bench is close to the river, and the upper, thirty feet above it, is of more stony soil. "Cherries are dead or dying, almonds, apricots, peaches, etc., suffer from spring frosts. "The pears do very well." This orchard, like its neighbors, has been unprofitable.

A FEW SUCCESSFUL ORCHARDS.

There are a few places in the districts which have been described where men of unusual energy have done fairly well with deciduous orchards. The history of these enterprises thus, in some degree, relieves the otherwise gloomy records.

The Reynolds Orchard.—This is small, not over three acres. It is situated a mile east of the sub-station on the Huerhuero, and was planted in 1885 and later. The soil is a deep, alluvial loam, and "it is only ten feet to water." Apples, pears, peaches, and some other fruits, were planted. "All have made good growth and are healthy, excepting the apricots, which die down and finally succumb." Peaches bore every other year until 1898. Apples, pears, and prunes bear every other year and sometimes a large crop. Cherries have failed entirely. Grapes do well. The late frosts are the only drawback to the orchard (apricots and cherries excepted). Mr. Reynolds is able to irrigate from the stream, with a pump, in dry seasons and this, of course, makes a great difference. But he does not think an orchard profitable, even in this favorable location.

The Corbaley Orchard.—The next example illustrates sheer grit under hard conditions. Mr. J. B. Corbaley, who lives on the south bank of the Estrella, about two miles southeast of San Miguel, had



PLATE 15
NEGLECTED ORCHARD

twenty-five acres of deciduous fruits planted in 1890 and 1892, and took out five acres which did not pay. His soil is upland, granitic; no irrigation possible. Cherries died; apricots, almonds, and prunes fail in some years. Peaches, nectarines, apples, and pears have done well; "pears always bear." The prunes are poor, and he will substitute peaches, Mr. Corbaley "prunes heavily and thins heavily, plows and cultivates twelve times a year." He says that "fruit pays better than wheat." He grows melons and vegetables as well as fruit, and finds a local market. Peaches and pears are his most profitable fruits. "Late frosts are the greatest drawback."

The Webster Orchard.—The illustrations, pages 39-40, (plates 16 and 17) show the advantages offered by the so-called "Salinas bottom" on either east or west sides of the river, which are too frosty for many fruits. Mr. G. Webster, a well-known lawyer of Paso Robles and San Miguel, owns a farm half a mile from the latter town. Here he began to plant trees in 1893, and has continued until his orchards, in 1900, covered twenty five acres (pears, peaches, apricots, and prunes), and he planted in 1901 some 1700 Bartlett trees, making nearly thirty acres altogether of this pear, his best crop.

All his trees near the river bottom, a few feet above the sandy bed of the stream and on a light, rich loam, have grown well; trees on higher bench lands, twenty to forty feet above the former, have suffered from drought. The larger part of the orchard is about fifteen feet from the water. The culture consists of several plowings, and late spring cultivation. The orchard is well pruned. A part of the orchard has been in bearing since 1896. In 1900 everything "excepting pears" failed by reason of frost. Mr. Webster, on land just east of the river, "had only one failure of the pear crop in ten years."

Peaches sell in the local market, and are dried, but neither peaches nor prunes pay well. Apricots have not succeeded. Pears are "much the best crop here." The Bartlett pears grown by Mr. Webster, as well as all pears produced in the region, wherever the soil is suitable and the moisture sufficient, both east and west of the Salinas and north as well as south of San Miguel, are of unusual quality and beauty. Besides, the Bartletts are very late, and so find ready sale at the canneries in San José and elsewhere. Mr. Webster's pears are all sold by contract at a good price. He finds his pear orchard profitable, and is extending it rapidly.

The Steinbeck Orchard.—There is a noted orchard at Templeton (shown on first page) where 1600 Bartlett pears and a small collection of other fruits, were planted in 1890 on two benches, one low, just above the river, the other higher and on more gravelly soil, underlaid



PLATE 16
ORCHARD OF G. WEBSTER
(Mesa Plateau beyond)



PLATE 17
BARTLETT PEAR ORCHARD
(G. Webster's orchard)

by siliceous rock. The lower orchard is 15 feet to water; the upper is 25 to 30 feet.

The apples failed in 1900, but bore well other years; "summer varieties do best." The prunes "bore only once, in 1897." Peaches bear in some years. But pears are "the only profitable fruit, and that only on the lower bench," as in some seasons there is not enough moisture on the upland to mature a crop. In 1899 the crop was sold to San José canneries, delivered at the railroad station, for \$42.50 per ton, sizes two and a half inches and upward. In 1900 the price obtained, delivered in San Francisco, was \$25.00 per ton, sizes two and a quarter inches and upward.

In this orchard the Bartletts ripen earlier than at the sub-station and in some other orchards. In 1897, fruit was shipped before August 12th; in 1898 from August 18th to September 5th; in 1899 from August 21st to September 1st; in 1900 August 30th. Bart-

letts of large size and high quality are grown at the sub-station on the adobe soil, and, of course, without irrigation, ripening in mid-autumn. Picked September 29, 1897, they were fit for table use October 7th. The highest-priced Bartletts grown in this entire region will be such late fruit as this, produced on heavy soils in the hills, not always necessarily on the river bottoms. The experience, however, of Mr. Steinbeck, Mr. Webster, Mr. Reynolds, and others shows the road to commercial success on lands near the streams, whether the fruit be late or early.

The Nelson Orchard.—In order to show the conditions which prevail in the foothills east of the Salinas, though only a few miles distant, the orchard of Andrew Nelson, two miles northwest of Paso Robles was examined (page 42, plate 18). Here are twenty acres of mixed orchard, on a black loam underlaid by bituminous shale, and in places by limestone. Some of it is an ashy adobe. All is on rather steep slopes. The fruits growing here are almonds, nectarines, plums, prunes, apples, pears, figs, and oranges (which last were never injured by frost). Part of the trees were planted in 1890 and part in 1897. There has never been a failure of the fruit crop at this place; the trees grow well, though not large, and appear healthy. Mr. Nelson finds "fruit growing profitable for the local market," especially "when the late spring frosts destroy the crops in the valley and east of the river."

HISTORY OF FRUIT-GROWING IN THIS REGION.

In the light of these notes, (1) from the sub-station between 1889 and 1902, (2) from the actual experience of those land-owners in the region who have made the most strenuous, and, on the whole, the most successful efforts to grow fruit, a brief account of the earlier history of the industry here tends to cast light upon its probable future. My authorities are the files of the early newspapers, my own observations, and the testimony of nurserymen and their agents, also the evidence of all the farmers interviewed.

Settling Eastern San Luis Obispo.—The story is one of a great and praiseworthy awakening of an entire community. Many of the investments then made were poor or worthless, but there was very little deliberate fraud. All men believed in this new, rich, beautiful region; those who have suffered most are still believers in the future of eastern San Luis Obispo and southeastern Monterey. Its story has been told with great force, skill, and truthfulness by Mr. Vachell, the novelist, in his "The Profession of Life," whose "Clumville" is Creston.

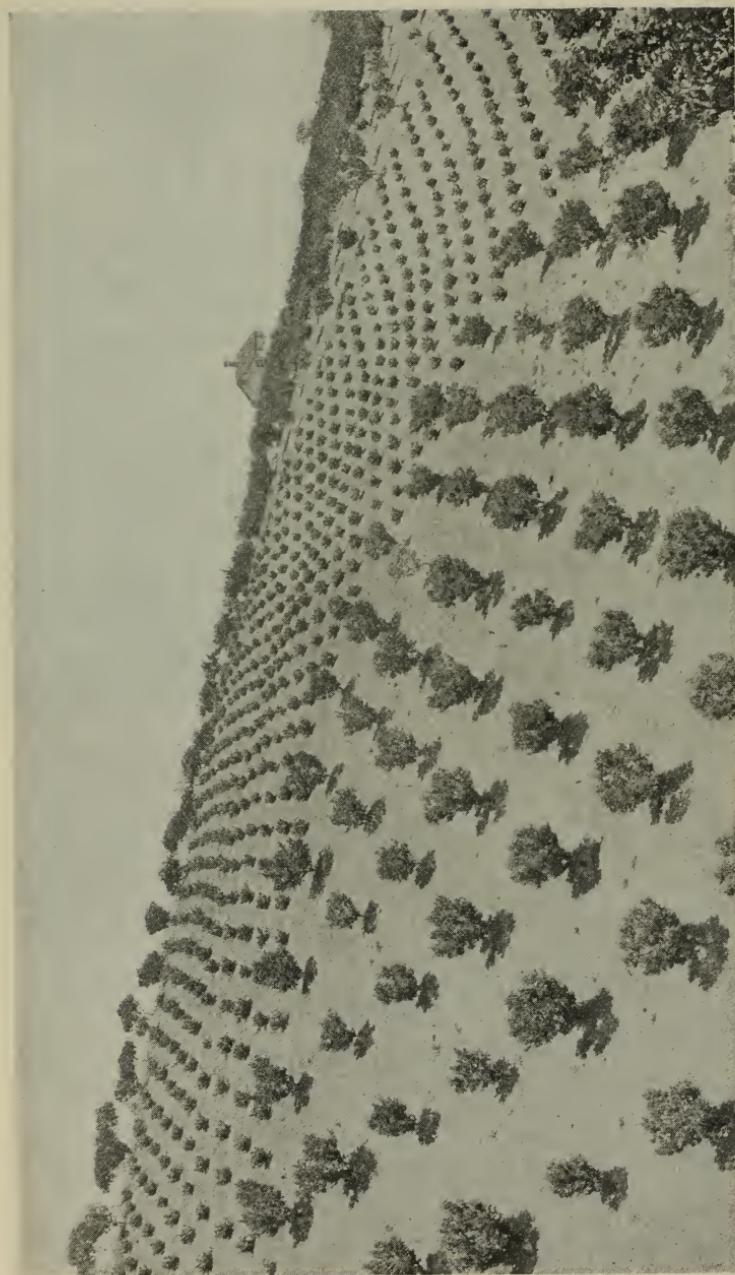


PLATE 18
ORDHARD OF ANDREW NELSON

Turning back to 1879, ten years before the sub-station was under way, a speculator of Napoleonic energy, C. H. Phillips, was breaking up the old Spanish ranches with every prospect of establishing upon them thousands of prosperous homes. His pamphlets said, "Paso Robles Rancho, 26,000 acres, adapted to wheat and grazing; Santa Ysabel Rancho, 23,000 acres, well watered, large amount of timber (oak); Eureka Rancho, 25,640 acres; Asuncion, Atascadero, and Santa Margarita ranches, in all 60,000 acres, and the Huerhuero Rancho of 43,000 acres." In addition to these were many smaller ranches east of the Salinas, and a great deal of government land. Incidentally, stress was laid upon the value of much of these lands for fruit growing, but cattle and the cereals were undoubtedly considered the main resource, and "wheat was king."

Views of the Pioneers respecting Climate.—The climate, broadly speaking, was very attractive to many persons, and the country was and is strikingly beautiful with its rolling hills and oak forests. Rainfall, as far as could be ascertained, though sometimes short, seemed as a rule sufficient for wheat. The few American pioneers gave about the following account: 1861, "very wet"; 1862, a "good grass year;" 1863, "very dry"; 1864-68, "fair average rains"; 1870, "dry"; 1871-74, "good medium years"; 1875, "very wet"; 1876, "dry and cold"; 1877, "a wet year"; 1878, an average season; 1879, "wet and warm." With such reports it is no wonder that the literature of the period spoke of the upper Salinas as another Santa Clara of the north, and predicted that "cities like San José would spring up along its course and that of its tributaries." Accurate observations of its rainfall and temperature would in all probability show that the climate had not noticeably changed during a half century. Myron Angel's "History of San Luis Obispo County," published in 1883, says of San Miguel, "The lack of water is most pronounced and effectually debars the cultivation of most agricultural products save in exceptional years," and he mentions in 1878 a "cold spell" of 16° Fahr. As for the Estrella region, he speaks of droughts as occurring "two years in five," and, as this was from the standpoint of wheat culture, it would measurably agree with conditions during two decades since.

Early Faith in Orchards.—Some tree planting had been done in the Santa Lucia Mountains, in the Summit School district, as early as 1870 I sold trees myself to the pioneers there, and some are still bearing fruit. Tree planting in the valley followed fast upon the extension of the railroad, the laying out of Templeton, and the sale of lands east of the Salinas. In 1888 the *Paso Robles Leader* said, referring to the immense region east of the Santa Lucia Mountains,

some 1,100,000 acres, "two-thirds of which was vacant, held for speculation or occupied for grazing", that "throughout this region, wherever tried, fruit of many varieties and of finest quality is grown."

Orchard Planting on a Large Scale and the Results.—Between 1885 and 1893 the planting of fruit trees on a commercial scale went on in all the farming regions tributary to the towns along the Salinas between San Ardo and Santa Margarita, fifty-three miles. Oranges, lemons, figs, olives, and other semi-tropic fruits were often planted, as well as all the deciduous fruits and small fruits known to the trade. Nurserymen sent out agents; places called "yards" for the sale of trees were opened in the towns. One then saw dozens of farmers coming in with wheat and going out with from 50 to 100 trees apiece.

Even in localities well adapted to fruits a large proportion of the trees sold by nurserymen never reached bearing age, by reason of neglect or ignorance. In new districts and those where, as it turns out, the difficulties in the way of success are very great, this percentage of loss was indefinitely increased. It is the opinion of those who sold trees during the "boom" years in these towns that more than one million trees of the leading deciduous fruits were sold and planted. Theoretically, this should have produced 10,000 acres of orchard; in practice it has produced only a few hundred acres, mostly west of the Salinas. East of the river, as these observations prove, there are only a few small and unprofitable orchards remaining out of all the planting done through so many years, and done in not a few cases by men of long practical experience in fruit growing in other parts of California. Settlers came here from Sonoma, Alameda, Santa Clara, Santa Cruz, Santa Barbara and other counties, as well as from the coast valleys of San Luis Obispo. They were therefore able to put average California methods into practice to some extent from the beginning, and if the region had been fairly well adapted to the culture of these fruits, they would doubtless have succeeded. Their almost total lack of success with nearly all kinds of fruits planted can be attributed only to soil and climate.

CONCLUSIONS.

The Sub-Station Records.—In the preceding pages are gathered up very briefly, if the mass of material collected be considered, the practical evidence on deciduous fruit culture in the region under consideration. The reader is further referred to the following articles in the Reports of this station: Report of 1887-8, published in 1889, pp. 13-16; Report of 1888-89, published in 1890, pp. 89-111, also in appendix, list of fruit trees planted at the Southern Coast Range sub-station; Report of 1890, published in 1891, pp. 278-287; Report

of 1891-92, published in 1893, pp. 35-46, 150-152, and 193-202; Report of 1892-4, published in 1894, pp. 379-401, also in appendix, list of fruits planted at Southern Coast Range Station; Report for 1895-7, published in 1898, pp. 248-253, also 329-346; Report for 1897-8, p. 224, and pp. 278-292. This makes a total of 139 pages, besides the appendices, devoted to the records of the sub-station, and this consists chiefly of notes on soil, climate, orchard and vineyard history and other cultures. The conclusions drawn from this material, and from all other station records, too voluminous to be used in full, have gone to the writing of this bulletin.

Sub-Station Conclusions.—As regards the sub-station tract and land similarly situated in respect to water, to rainfall, to frosts, and to characters of soil, conclusions are as follows:

Given as conditions, a total annual rainfall sometimes as low as 4.75 or 5.58 inches, a small water supply wholly inadequate for irrigation, lifted from deep wells; killing frosts in the blossoming season and a light, granitic soil on hardpan, fruit trees cannot be successfully grown. Given a better soil free from hardpan, and especial care in culture, pruning and treatment, and pears succeed. Pear trees and hardy American plums will bear well in ordinary seasons, that is, in four years out of five, and by thorough cultivation can be carried through dry years without injury. On such soils, apples are likely to bear three years out of five, and peaches and nectarines will bear two years out of five. Persian mulberries will bear almost, or quite, every year. Grapes can be expected to yield fairly in four years out of five.

Neglect in culture or pruning, failure to destroy the borers or to start young trees very low, will end in the ruin of such an orchard, which is a highly artificial and most difficult product. On such land the pear would come nearest to actual profit. These discoveries of the value, in very arid and frosty locations, of these few fruits, and of the uselessness of planting on such hardpan, if properly heeded, should save land-owners much loss hereafter. So varied are the farms east of the river that on many farms a more suitable place for an orchard can be chosen, and the value of the farm thus increased.

General Conclusions about the District. Reviewing the entire history of the efforts to establish orchards east of the Salinas, it is clearly evident that the most severe losses have everywhere occurred in *almonds, cherries, prunes and apricots*. It is useless to plant these anywhere, excepting in a few sheltered spots, on good, well-watered soil; and, in fact, their culture belongs a considerable distance west of the river. Even four miles west of Santa Margarita (the Baron

Von Schröder ranch) 240 acres of prunes have been dug out, as the crop was invariably destroyed by frost. Measured by the standard of a commercially profitable tree elsewhere, not one first-class cherry, almond or apricot was found east of the Salinas River in 1900 or 1901, although the region was searched with great care. Thus measured, very few peaches or nectarines, plums or prunes have been found east of the river. Good apple trees were not numerous, but when on suitable soil they did fairly well, and there is sufficient evidence that peaches can be grown successfully in many locations and in ordinary seasons.

On rich soil, sufficiently moist, pears are the safest fruit crop for this entire district, as they withstand frosts well, and the quality of the pears is higher in this hot, dry climate than that of apples. For market, then, one must depend at present upon pears, and on lighter soils upon grapes. If peaches bear, and the trees are healthy, add peaches. For home use, plant grapes, pears, apples, peaches, nectarines, American and hardy plums and Persian mulberries. Among small fruits, if some irrigation can be practiced, plant strawberries and Loganberries, which do very well. For a few years and in some seasons Russian types of Morello cherries will bear quite well, but the trees will perish in a few years. Japanese plums blossom too early in the spring to be safe from frost; in sheltered locations they are valuable, but should be worked on peach roots. The very few cases where figs, olives, apricots and walnuts have borne fruit regularly east of the river, are due to local conditions that do not exist to any general extent.

The problem is really reduced to very simple terms. As a *tour de force*, the sub-station has carried a young orchard on fairly good soil through a season of 4.7 inches of rainfall without loss or injury. But such a season would seriously hurt large, bearing trees. The early winter and late spring frosts can be largely avoided by choice of better local conditions and by selecting the hardier fruits. Poorer soils can profitably be fertilized for small orchards. But the difficulty of a fluctuating rainfall, sometimes insufficient for healthy tree growth, and this in a region of rolling hills, scantily watered and not at present capable of irrigation excepting on small areas of bottom lands, constitutes the fundamental problem. The most hardy fruits may be selected, planted on the strongest soil, headed low, cultivated and cared for with extreme skill, patience and labor; still, if the land lacks moisture sufficient to maintain these trees in health during dry years, what avails it all?

This question has faced the student at every turn for thirteen

years, in every orchard east of the Salinas, whether of ten trees or ten acres, across the Estrella plains, along the Huerhuero, on the arid slopes east of San Miguel, Bradley and San Ardo, where hard-working American pioneers are doing their best to make a living and to improve their homesteads. These people will do all that American communities can to develop their region by depending upon arid-land crops, forage-grasses, salt-bushes, thorough summer-fallow for cereals, larger areas made pastoral, and the utmost using of irrigation where available. To them in the end, out of more exact knowledge, more capital, and concentration on a few things, greater prosperity will come.

Land-owners should root up stunted, unfruitful trees, which "cumber the ground." If they desire small orchards (so well worth having when successful) they should select location and varieties in accordance with the best experience herein given, and they should at first plant only a few trees, unless conditions for obtaining water are especially favorable. They should utilize, in dry seasons, even the smallest sources of water supply, and all their orchard practice should be of the most approved thoroughness. Fruit, barring exceptional cases and exceptional men, should be only a secondary resource of the land-owners in the region east of the Salinas.

But the advice of the station respecting fruits, summed up from observation and experience of many persons during a long period of years, is against large or costly experiments. Grapes can be grown at little expense, over a large area, to fill local needs for table and wine uses, but not for high-class raisins. A few fruits can often be grown quite well, with care, on a small scale, for family use; a still smaller list promises commercial returns in picked locations. The average farmer, busy with his grain-fields and pastures, is unlikely to give the proper care and outlay to such difficult work as this. Therefore, few more orchards will be planted until several wet and warm years such as have before occurred again rouse public interest. When this happens the prudent land-owner will "go slow," remembering past droughts and frosts.

Other resources of the Region.—Many prosperous districts in America depend agriculturally upon other things than fruit. The resources, visible or latent, of the territory described in this bulletin are ample enough to justify permanent investments. All of the "hardpan" soil will produce hardy Eucalypts and many other valuable forest trees, also salt-bushes, and other forage plants whose roots, like those of the native oaks, have the power of penetration. The cereals also grow on such soil with even small rainfall.

The location of the sub-station in part upon this physical hardpan, has resulted in the trial of a great number of plants here, and in much evidence respecting its value as well as its disadvantages. The winter's rainfall passes through it, and is in large degree stored up beneath. Plants whose roots can penetrate it to any useful extent are therefore invaluable here, and the list of such plants is being steadily increased.

The area of stronger soils, free from this peculiar hardpan, is large, and here the range of profitable crops becomes correspondingly greater. It has not been the province of this bulletin to discuss these broader possibilities of the region, but nothing herein written can justly be taken as implying their absence. On the contrary, such facts as those given respecting orchard limitations east of the river will, it is hoped, guide future investors to more profitable crops than fruit, and especially to a more general use of suitable forage plants and trees with penetrative roots upon neglected hardpan soils of this nature.

Many as yet but slightly developed fruit districts are scattered throughout the Santa Lucia Mountains immediately west of the territory under consideration in this bulletin, and from thence the dwellers on hardpan and the more arid soils east of the river will eventually draw much of their fruit-supply.